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MEMORANDUM

DETERMINANTS OF REENLISTMENT AND EXTENSION RATES IN THE UNITED STATES MARINE CORPS

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NAVAL STUDIES GROUP

Work Conducted Under
Contract N00014-80-C-0664

This memorandum represents the best opinion of CNA at the time of issue. It does not necessarily represent the opinion of the Department of the Navy.

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In re: (CNA)82-1733 / 2 November 1982

MEMORANDUM TO THE ASSISTANT SECRETARY OF DEFENSE, MANPOWER, RESERVE AFFAIRS AND LOGISTICS (Attn: Mr. Paul Hogan)

Subj: Center for Naval Analyses Memorandum; forwarding of

Encl: (1) (CNA)82-1733 , "Determinants of Reenlistment and Extension Rates in the United States Marine Corps," 2 November 1982, Unclassified

Enclosure (1) contains the analysis that CNA has completed on Reenlistment and Extension Rates in the United States Marine Corps under contract N00014-80-C-0664.

JAMES C. WILSON
Director
Special Studies Program

EXECUTIVE SUMMARY

This paper analyzes the effects of Selective Reenlistment Bonuses (SRB) on retention rates among first-term and second-term enlisted personnel in the United States Marine Corps. Our sample contains the nearly 90,000 first-term and nearly 20,000 second-term enlisted personnel who made reenlistment decisions during the period FY 1975 to FY 1978. We classified those individuals into the six occupational clusters shown in Table I. Each occupational cluster consists of two-digit military occupational specialties that we judged to be similar in terms of skill requirements, tasks performed, and work environment.

Within each occupational cluster and fiscal year we may compute the reenlistment rate and the extension rate. The reenlistment rate is defined as the ratio of the number of reenlistment eligibles who sign contracts for three or more years of additional service divided by the total number of reenlistment eligibles. The extension rate is defined as the ratio of the number of reenlistment eligibles who sign contracts for less than three years of additional service divided by the total number of reenlistment eligibles. The sum of the reenlistment rate plus the extension rate is less than one, since many individuals choose to leave the Marine Corps rather than either reenlisting or extending.

TABLE I

MARINE CORPS OCCUPATIONAL CLUSTERS

UNCLASSIFIED

COMBAT

03 - Infantry
08 - Field artillery
18 - Tank and amphibian tractor

COMBAT SUPPORT

02 - Intelligence
13 - Engineer, construction equipment
25 - Operational communications
26 - Signals intelligence/ground electronics warfare
35 - Motor transport
57 - Nuclear, biological, and chemical

ADMINISTRATION AND LOGISTICS

01 - Personnel and administration
04 - Logistics
30 - Supply administration and operations
31 - Transportation

SERVICE

11 - Utilities
14 - Drafting, surveying, and mapping
15 - Printing and reproduction
21 - Ordnance
23 - Ammunition and explosive ordnance disposal
33 - Food service
34 - Auditing, finance and accounting
41 - Marine corps exchange
43 - Public Affairs
44 - Legal services
46 - Audiovisual
55 - Band
58 - Military police and corrections

TABLE I (Cont'd)

TECHNICAL

28 - Data/communications maintenance
40 - Data systems
59 - Electronics maintenance
66 - Avionics
72 - Air controller/air support/anti-air warfare
73 - Air traffic control and enlisted flight crews

AVIATION

60 - Aircraft maintenance (fixed wing)
61 - Aircraft maintenance (helo)
65 - Aviation ordnance
68 - Weather service
70 - Aviation operations

Individuals who reenlist (but not those who extend) receive an SRB payment. The SRB payment is computed as the product of: (1) monthly basic pay at the date of reenlistment, (2) length of reenlistment (measured in years), and (3) an SRB multiple, or level, ranging from 0 to 6.

We used logit analysis to determine the statistical relationship between the SRB multiple and the reenlistment and extension rates. Table II reports our results for first-term personnel. According to the table, a one multiple SRB increase to the combat cluster would increase the reenlistment rate by .0605 but decrease the extension rate by .0465. Since the increase in the reenlistment rate exceeds the decrease in the extension rate, the total probability of staying in the Marine Corps increases by .0140 (.0605 - .0465 = .0140). The results for the other five occupational clusters have similar interpretations.*

Table II may be used to predict the effects of an SRB decrease as well as an SRB increase. This is accomplished by simply reversing the signs of the numbers in the table. For example, a one multiple SRB decrease to the combat cluster would decrease the reenlistment rate by .0605, increase the extension rate by .0465, and decrease the total probability of staying in the Marine Corps by .0140.

*The standard errors of the effects in table II range between .001 and .002. Therefore, almost all of the effects are statistically significant. The only two insignificant effects are the small increase in the extension rate in the technical cluster and the decrease in the extension rate in the aviation cluster.

TABLE II

PARTIAL EFFECTS OF ONE MULTIPLE SRB INCREASE ON FIRST-TERM RETENTION[a]

Occupational cluster	Changes in rates: Stay (s)	Reenlist (r)	Extend (e)
Combat	.0140	.0605	-.0465
Combat Support	.0254	.0723	-.0469
Administration/ Logistics	.0366	.0828	-.0462
Service	.0349	.0592	-.0243
Technical	.0162	.0149	.0012
Aviation	.0316	.0318	-.0002

[a]Based upon the FY 1982 pay table, a one level SRB increase corresponds to an increase in the annualized bonus payment of $820.

Table II may also be used to predict the effects of increasing or decreasing the SRB payment by more than one multiple. This is accomplished by multiplying the numbers in the table by the change in multiples. For example, consider increasing the SRB payment to the combat cluster by two multiples (e.g., increasing the SRB multiple from 1 to 3). Doubling the numbers in Table II, we predict that the reenlistment rate would increase by .1210, the extension rate would decrease by .0930, and the total probability of staying in the Marine Corps would increase by .0280.

Table III reports our results for second-term personnel.* The interpretation of table III is identical to that of table II. However, the effects of SRB changes are stronger for second-term personnel than for first-term personnel. For example, a one multiple second-term SRB increase to the aviation cluster would increase the reenlistment rate by .1600, decrease the extension rate by .0512, and increase the total probability of staying in the Marine Corps by .1087.

TABLE III

PARTIAL EFFECTS OF MULTIPLE LEVEL SRB INCREASE ON SECOND-TERM RETENTION[a]

	Changes in rates		
Occupational cluster	Stay (s)	Reenlist (r)	Extend (e)
Combat	.1000	.0786	.0214
Combat Support	.0882	.0721	.0161
Administration/ Logistics	.0880	.1367	-.0487
Service	.0774	.1304	-.0530
Technical	.0978	.1298	-.0320
Aviation	.1087	.1600	-.0512

[a]Based upon the FY 1982 pay table, a one level SRB increase corresponds to an increase in the annualized bonus payment of $1,060.

*The standard errors of the effects in table III range between .002 and .007. All of the effects are statistically significant.

TABLE OF CONTENTS

LIST OF TABLES

I. INTRODUCTION

This paper analyzes the determinants of reenlistment and extension rates among first-term and second-term enlisted personnel in the United States Marine Corps. In particular, we analyze the separate effects of regular military compensation and reenlistment bonuses on the probabilities of reenlistment and extension. The decomposition of retention into reenlistments of greater than three years and extensions of less than three years is important for several reasons. First, these two components of retention respond differently to various compensation incentives. For example, since only those who reenlist receive reenlistment bonuses, an increase in bonus levels will increase the reenlistment rate but probably decrease the extension rate. Moreover, the distinction between reenlistments and extensions is important because a shift in the mix of retention toward reenlistments and away from extensions implies a higher stock of contracted manyears and hence a larger and more stable enlisted force over time. We have estimated the magnitude of these effects separately for first-term and second-term personnel in each of six occupational clusters.

Section II of this paper describes our data set construction. Section III presents our statistical estimation techniques. Section IV reports our empirical findings, and Section V discusses our conclusions.

II. DATA

The data for this study were provided by the Defense Manpower Data Center (DMDC). DMDC maintains master and loss files that are extracts of the services' master records. From these files, DMDC constructed a longitudinal data file that tracks every enlisted individual in the Marine Corps who had more than 23 months of service on 1 July 1974 either to the time of termination of service or to 30 September 1978. Individuals who reached their 23rd month of service between 1 July 1974 and 30 September 1978 were similarly tracked. Each person's record contains both personal background data and military history data.

From these data we identified and extracted all of the individuals who made first-term or second-term reenlistment decisions during the period FY 1975 to FY 1978. The resulting data set contains nearly 90,000 first-term and nearly 20,000 second-term personnel. We then disaggregated the data into the six occupational clusters shown in table 1. Each occupational cluster consists of two-digit military occupational specialities (MOS) that we judged to be similar in terms of skill requirements, tasks performed, and work environment.

Tables 2 and 3 present summary retention statistics by occupational cluster and fiscal year for first-term and second-term personnel respectively. The probability of staying, s, is defined as the ratio of the number of reenlistment eligibles who choose to stay in the Marine Corps

TABLE 1

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TABLE 2

FIRST-TERM RETENTION STATISTICS AND
AVERAGE BONUS MULTIPLES

Occupational cluster	Fiscal year	Rates			Average bonus multiple	Number of reenlistment eligibles
		Stay (s)	Reenlist (r)	Extend (e)		
Combat	1975	.331	.131	.200	0.948	4,284
	1976	.271	.113	.158	0.927	4,889
	1977	.269	.126	.143	0.846	6,033
	1978	.224	.136	.088	0.389	5,820
Combat Support	1975	.333	.168	.165	1.000	4,903
	1976	.310	.161	.149	1.119	5,411
	1977	.308	.176	.132	0.898	5,535
	1978	.242	.132	.110	0.660	5,806
Administration/ Logistics	1975	.459	.289	.170	0.964	3,129
	1976	.417	.231	.186	0.935	2,951
	1977	.448	.291	.157	0.712	3,487
	1978	.346	.201	.145	0.300	3,220
Service	1975	.340	.217	.123	1.146	2,972
	1976	.282	.172	.110	1.111	3,367
	1977	.335	.214	.121	0.983	2,688
	1978	.321	.200	.121	0.802	2,396
Technical	1975	.299	.241	.058	1.744	2,157
	1976	.296	.211	.085	2.628	1,789
	1977	.329	.232	.097	1.757	2,046
	1978	.277	.183	.094	2.438	2,183
Aviation	1975	.276	.205	.071	1.504	2,825
	1976	.286	.177	.109	1.032	2,975
	1977	.338	.227	.111	1.170	3,005
	1978	.278	.153	.125	0.794	3,082

TABLE 3

SECOND-TERM RETENTION STATISTICS AND
AVERAGE BONUS MULTIPLES

Occupational cluster	Fiscal year	Rates			Average bonus multiple	Number of reenlistment eligibles
		Stay (s)	Reenlist (r)	Extend (e)		
Combat	1975	.498	.336	.162	0.000	837
	1976	.511	.252	.259	0.000	858
	1977	.600	.292	.308	0.000	835
	1978	.634	.300	.334	0.000	860
Combat Support	1975	.579	.378	.201	0.000	821
	1976	.532	.302	.230	0.039	774
	1977	.635	.279	.356	0.138	886
	1978	.588	.247	.341	0.205	1,007
Administration/ Logistics	1975	.673	.497	.176	0.000	733
	1976	.614	.304	.310	0.000	694
	1977	.631	.291	.340	0.000	901
	1978	.657	.277	.380	0.000	1,210
Service	1975	.629	.424	.205	0.000	599
	1976	.628	.311	.317	0.015	615
	1977	.675	.312	.363	0.155	664
	1978	.637	.280	.357	0.305	944
Technical	1975	.558	.369	.189	0.000	471
	1976	.587	.294	.293	0.006	635
	1977	.554	.273	.381	0.176	830
	1978	.525	.198	.327	0.224	1,000
Aviation	1975	.640	.456	.184	0.000	434
	1976	.644	.323	.321	0.023	570
	1977	.579	.269	.310	0.043	814
	1978	.586	.241	.345	0.015	945

to the total number of reenlistment eligibles. We further decompose s into the reenlistment rate, r, and the extension rate, e. The reenlistment rate is defined as the ratio of the number of reenlistment eligibles who sign contracts for three or more years of additional service to the total number of reenlistment eligibles. The extension rate is defined as the ratio of the number of reenlistment eligibles who sign contracts for less than three years of additional service to the total number of reenlistment eligibles. Note that $s = r + e$.

Our data exclude individuals declared ineligible to reenlist. Moreover, our data exclude early reenlistments that occur more than 12 months prior to the end of the old enlistment or reenlistment contract. Both factors make it difficult to compare our retention statistics to official statistics, which use a different definition of eligibility.

Individuals who reenlist (but not those who extend) receive a Selective Reenlistment Bonus (SRB). The SRB is computed as the product of: (1) monthly basic pay at the date of reenlistment, (2) length of reenlistment (measured in years), and (3) an SRB multiple, or level, ranging from 0 to 6. The SRB is set by the Marine Corps on an MOS basis each fiscal year in an attempt to achieve the desired reenlistment rate in each MOS. Tables 2 and 3 present the average bonus multiples that first-term and second-term personnel in each occupational cluster and fiscal year would have received had they all reenlisted. The average

bonus multiples actually paid to the fraction of personnel who chose to reenlist may differ from the numbers presented in the tables. Note that SRB levels were equal to zero for all second-term personnel in combat and administration/logistics, so that no reenlistment bonuses were available to these individuals during our sample period.

The Selective Reenlistment Bonus System is the successor to the earlier Regular Reenlistment Bonus (RRB) System that it replaced on 1 July 1974. Individuals who entered the Marine Corps prior to this date but who executed first-term reenlistment contracts after this date in an MOS with a level zero SRB still received a level one RRB. To reflect this fact, we identified all first-term personnel with active duty service dates prior to 1 July 1974 who made reenlistment decisions in an MOS with a zero SRB, and we recoded their SRB levels from zero to one. Most of the individuals in our sample who received an RRB did so in either FY 1975 or FY 1976. The phasing out of the RRB program explains most of the general decline in the first-term average bonus multiples over our sample period.

The SRB payments were made in annual installments prior to 1 April 1979. Hence, this was the policy throughout the entire period spanned by our data. However, current policy is to pay 50 percent of the bonus in a lump-sum at the date of reenlistment and the remaining 50 percent in annual installments over the duration of the reenlistment contract. Since lump-sum bonuses are more effective than installment bonuses [1], we adjusted our estimates to reflect the change to the current policy.

Tables 4 and 5 present the proportionate distribution of the first-term and second-term samples by marital status, education, race, and AFQT mental group. All of these variables are measured at the date of the reenlistment decision. Note that the percent of individuals with more than 12 years of education is highest in the Technical cluster, and the percent of individuals in mental groups 1 and 2 is highest in the Technical and Aviation clusters. Note also that the percent married is much higher among second-termers than among first-termers.

III. STATISTICAL TECHNIQUES

We employed a sequential logit model for the decision to reenlist, extend, or leave the Marine Corps. That is, we used one logit model to represent the decision to stay or leave the Marine Corps, and a second logit model to represent the decision to reenlist or extend among those who stay in the Marine Corps.

We assume that the probability of staying in the Marine Corps is a logistic function of the annualized or annuitized difference between the military income stream from staying in the Marine Corps and the civilian

TABLE 4

PROPORTIONATE DISTRIBUTION OF FIRST-TERM SAMPLE

	Fraction of sample in indicated group								
		Education				AFQT mental group			
Occupational cluster	Married	<12	=12	>12	White	1-2	3	4	Missing
Combat	.335	.357	.602	.041	.740	.150	.487	.154	.209
Combat support	.367	.344	.614	.041	.799	.177	.513	.114	.196
Administration/logistics	.406	.212	.704	.084	.754	.189	.449	.110	.252
Service	.405	.205	.712	.082	.837	.252	.499	.086	.163
Technical	.370	.073	.790	.137	.948	.661	.214	.012	.113
Aviation	.437	.196	.763	.041	.909	.455	.447	.009	.089

TABLE 5

PROPORTIONATE DISTRIBUTION OF SECOND-TERM SAMPLE

	Fraction of sample in indicated group								
		Education				AFQT mental group			
Occupational cluster	Married	<12	=12	>12	White	1-2	3	4	Missing
Combat	.760	.136	.781	.083	.724	.082	.288	.139	.491
Combat support	.759	.124	.796	.080	.827	.135	.291	.099	.475
Administration/logistics	.782	.062	.817	.120	.813	.131	.322	.111	.436
Service	.788	.067	.816	.117	.825	.156	.352	.088	.404
Technical	.769	.019	.739	.242	.954	.491	.137	.009	.363
Aviation	.812	.043	.873	.084	.929	.348	.290	.013	.349

income stream from leaving the Marine Corps.* We will now discuss the procedures that we employed to compute the military and civilian income streams for each individual in our sample.

We first computed the present value at a 10 percent discount rate of the military income stream that each individual could expect over the horizon of a 4-year reenlistment. We included both regular military compensation (RMC) and any bonus that the individual would receive if he reenlisted. Our RMC values incorporated the individual's expected promotion path given his length of service (LOS) and paygrade at the date of the reenlistment decision.

We next computed the present value at a 10 percent discount rate of the civilian income stream that the individual could receive over the same 4-year time horizon. To obtain variation in civilian income by LOS, we began with an age-earning profile for white high school graduates from the March 1977 Current Population Survey (CPS). We deflated this profile to FY 1975 dollars using an index of average hourly earnings of workers in the manufacturing industry. We also computed the

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* Consider an income stream $Y_1,\ldots,Y_T$. The annualized value of this income stream at discount rate d is defined as:

$$T^* = \sum_{t=1}^{T} Y_t (1+d)^{-t} \Big/ \sum_{t=1}^{T} (1+d)^{-t}$$

Observe that a constant income stream of Y* over a T-period horizon has the same present value as the original income stream.

ratio of this index to the consumer price index. We normalized both indices to 1.00 in FY 1975. The ratio of the two normalized indices increases over time if there is real (i.e., inflation-adjusted) growth in civilian wages relative to the base year FY 1975, but decreases over time if the opposite is true. We scaled our FY 1975 age-earning profile by the ratio of indices to obtain age-earning profile for each of FY 1976 to FY 1978, all expressed in FY 1975 dollars.

The age-earning profiles incorporate variation in civilian earnings across individuals by LOS and fiscal year. To obtain further variation by race and education level, we calculated average earnings differences in the March 1977 CPS between whites and non-whites, and among individuals with less than 12 years of education, those with exactly 12 years of education, and those with more than 12 years of education. We obtained estimate of earnings differences by mental group from Ross and Warner [2]. These sources provided the following percentage adjustment factors:

< 12 years of education versus 12 years:	-16.5 percent
> 12 years of education versus 12 years:	+14.8 percent
Non-white versus white:	-20.0 percent
Mental group 1-2 versus mental group 3:	+ 3.2 percent
Mental group 4 versus mental group 3:	- 6.8 percent

We adjusted each individual's civilian earnings as computed from the age-earnings profile to account for differences in race, education level, and mental group. We applied the adjustments sequentially to account for each of these factors. The adjustments added considerable variation to the civilian earnings values. For example, a white individual in mental group 1 with more than 12 years of education received adjustments of 14.8 percent for education and 3.2 percent for mental group. This resulted in a compounded upward adjustment of (1.148)(1.032)-1 or 18.5 percent. A black individual in mental group 4 with less than 12 years of education received downward adjustments of 16.5 percent for education, 6.8 percent for mental group, and 20.0 percent for race. This resulted in a compounded downward adjustment of 1-(1-.165)(1-.068)(1-.200) or 37.7 percent. Hence, adjustments for race, education, and mental group served to widen the difference in civilian earnings between these two individuals by a total of 18.5 + 37.7 = 56.2 percent.

Let M denote the annualized value of RMC, B the annualized reenlistment bonus, and C the annualized value of civilian earnings, all computed at a 10 percent discount rate over a 4-year time horizon. Also, let D_{76}, D_{77}, and D_{78} be dummy variables equal to one if the individual made his reenlistment decision in the year indicated by the

subscript, and zero otherwise. Then we express the probability of staying in the Marine Corps (s) as:

$$\log [s/(1-s)] = \alpha_0 + \alpha_1 (M+B-C) + \alpha_2 D_{76} + \alpha_3 D_{77} + \alpha_4 D_{78} \qquad (1)$$

where log denotes the natural logarithm operator.

The maximum likelihood procedure enables us to estimate the coefficients in equation (1) using only the information on each individual's decision to stay or leave, his value of (M+B-C), and the year in which his decision was made. Once the coefficients have been estimated, equation (1) may be used to predict the probability of staying for a new individual drawn from outside of the original sample.

The dummy variables for fiscal year in equation (1) are included to capture the effects of time-dependent variables such as the civilian unemployment rate. We have not estimated the model using the unemployment rate itself in place of the set of dummy variables. Therefore, we have no direct estimate of the effect of civilian unemployment on Marine Corps reenlistment decisions. However, the dummy variables control for the effects of civilian unemployment as well as any other time-dependent variables that affect reenlistment decisions. Hence, α_1 measures the pure effect of relative pay on the probability of staying in Marine Corps.

We assume, that among those who choose to stay, the probability of reenlisting rather than extending is a logistic function of the annualized reenlistment bonus and the dummy variables for the decision year:

$$\log (r/e) = \beta_0 + \beta_1 B + \beta_2 D_{76} + \beta_3 D_{77} + \beta_4 D_{78} \qquad (2)$$

We adopt this specification because, apart from the higher cumulative promotion rate, the reenlistment bonus is the major monetary incentive to reenlist rather than extend. Once again, although equation (2) is a probability model, it may be estimated using only information on each individual's decision to reenlist or extend, his value of B, and the year in which his decision was made.

In addition to predicting probabilities for particular individuals outside of the original sample, we may use equations (1) and (2) to derive the partial derivatives of the probabilities of reenlisting, extending, staying, and leaving with respect to various pay changes. The partial derivatives represent the changes in the probabilities that would result from specified pay changes. In particular, the partial derivatives could be used by bonus managers to predict the effects of changes in SRB levels on the probabilities. This would enable bonus managers to choose SRB levels that will achieve desired retention rates and the desired mix between reenlistments and extensions.

The partial derivatives are presented in table 6. The second column gives the changes in the probabilities associated with a one dollar annual increase in RMC. By construction, the change in the probability of staying equals the sum of the changes in the probabilities of reenlisting and extending. Also, the change in the probability of staying plus the change in the probability of leaving sum to zero.

The third column in table 6 gives the changes in the probabilities associated with a one dollar increase in the annualized bonus payment. Once again, the change in the probability of staying equals the negative of the change in the probability of leaving and also equals the sum of the changes in the probabilities of reenlisting and extending.

Note also that, with the sequential logit model represented by equations (1) and (2), the changes in the probability of staying are equal for a one dollar increase in annual RMC and a one dollar increase in the annualized bonus payment. However, the mix of reenlistments and extensions among stayers is quite different for the two types of pay increases. An increase in RMC increases both the reenlistment rate and the extension rate by the same percentage relative to their base values. This follows since an increase in RMC does not imply any increase in B and, from equation (2), the mix between reenlistments and extensions is unchanged as long as B remains constant.

TABLE 6

PARTIAL DERIVATIVES OF THE PROBABILITIES
WITH RESPECT TO PAY

		Effect of dollar increase in:	
Probability		RMC	Annualized bonus payment
Reenlist:	r	$r(1-s)\alpha_1$	$r(1-s)\alpha_1 + e(r/s)\beta_1$
Extend:	e	$e(1-s)\alpha_1$	$e(1-s)\alpha_1 - e(r/s)\beta_1$
Stay:	$s = r+e$	$s(1-s)\alpha_1$	$s(1-s)\alpha_1$
Leave:	$\ell = 1-s$	$-s(1-s)\alpha_1$	$-s(1-s)\alpha_1$

The effects are quite different for an increase in the bonus payment. The probability of staying increases, as does the proportion who reenlist among stayers. Both of these factors contribute to an increase in the reinlistment rate. However, although there are more stayers, the proportion of stayers who extend declines. Hence, the absolute number of extenders may decline as well.

Finally, consider the effect of increasing the SRB multiple by one level. If bonuses are paid in annual installments, then the annualized value of the bonus is simply monthly basic pay times the SRB multiple. Hence, a one level increase in the SRB multiple implies that the annualized value of the bonus increases by the value of monthly basic pay. Since the third column of table 6 gives the effect of a one dollar increase in the annualized value of the bonus, the effect of a one level

increase in the SRB multiple is obtained by multiplying the numbers in this column by the value of monthly basic pay.

To perform these computations, we first took the FY 1982 monthly basic pay of a typical first-term individual (E-4 at LOS 4) and a typical second-term individual (E-6 at LOS 8). These values are $820 and $1,060, respectively. We deflated these values to FY 1975 dollars using the consumer price index, and arrived at the deflated values $410 and $530. We also took account of the current bonus payment system in which 50 percent of the bonus is paid in a lump-sum at the date of reenlistment and the remaining 50 percent is paid in annual installments over the duration of the reenlistment contract. Under this system, the annualized value of the bonus is given by:

$$B = \frac{\left[.5 + \sum_{t=2}^{4} .167\ (1 + d)^{-t + 1} \right] (P)(SRB)(LOR)}{\sum_{t = 1}^{4} (1 + d)^{-t + 1}} \qquad (3)$$

where P denotes monthly basic pay and LOR denotes the length of reenlistment. A one level increase in the SRB multiple now implies a larger increase in the annualized value of the bonus than was the case under the old installment payment system. At a 10 percent discount rate, the annualized bonus increases by 1.05 times monthly basic pay. Hence, the effect of the bonus is magnified by 5 percent under the current system.

Therefore, we have multiplied our monthly basic pay values of $410 and $530 by the factor 1.05 to arrive at the values $431 and $557 that we employed in our computations.

Table 7 and 8 present the means and standard deviations of the pay variables used in our analysis. Again, B denotes the annualized re-enlistment bonus, while M denotes the annualized value of RMC and C denotes the annualized value of civilian earnings. Recall also that SRB levels were equal to zero for second-term personnel in combat and administrative/logistics throughout our entire sample period, so that B equals zero for these individuals.

IV. FINDINGS

Tables 9 and 10 present our maximum likelihood estimates of the coefficients α_1 and β_1 from equations (1) and (2), respectively. The lack of variation in SRB levels among second-term personnel in combat and administration/logistics precluded estimation of β_1 for these two occupational clusters.

Table 11 presents our estimates of the partial effects on first-term retention of a one level increase in the SRB multiple. These estimates are based upon FY 1982 pay levels and take account of the current bonus payment system in which 50 percent of the bonus is paid in the lump-sum and the remainder is paid in annual installments.

TABLE 7

MEANS AND STANDARD DEVIATIONS OF FIRST-TERM PAY VARIABLES[a]

Occupational cluster	B	M + B - C
Combat	271.60 (193.31)	82.92 (1,190.72)
Combat Support	327.32 (265.54)	109.92 (1,181.42)
Administration/ Logistics	265.39 (167.45)	19.145 (1,116.64)
Service	371.87 (222.39)	36.27 (1,079.63)
Technical	785.09 (488.76)	100.05 (993.31)
Aviation	414.75 (267.72)	32.09 (1,012.13)

[a]Standard deviations appear in parentheses. All variables are measured in FY 1975 dollars.

TABLE 8

MEANS AND STANDARD DEVIATIONS OF SECOND-TERM PAY VARIABLES [a]

Occupational cluster	B	M + B - C
Combat	0.00 (0.00)	1,009.20 (1,281.29)
Combat Support	45.61 (208.31)	985.40 (1,143.27)
Administration/ Logistics	0.00 (0.00)	997.12 (1,084.34)
Service	62.41 (207.20)	1,082.44 (1,183.41)
Technical	59.79 (197.27)	846.38 (1,059.23)
Aviation	10.23 (82.16)	1,009.70 (966.83)

[a]Standard deviations appear in parentheses. All variables are measured in FY 1975 dollars.

TABLE 9

COEFFICIENTS AND T-STATISTICS FOR FIRST-TERM MARINES [a]

Occupational cluster	α_1	β_1
Combat	.000164 (11.34)	.00186 (12.79)
Combat Support	.000283 (20.17)	.00185 (16.56)
Administration/ Logistics	.000350 (19.38)	.00141 (7.70)
Service	.000373 (18.35)	.00116 (7.86)
Technical	.000179 (7.06)	.000125 (1.39)
Aviation	.000353 (16.16)	.000392 (2.95)

[a] T-statistics appear in parentheses.

TABLE 10

COEFFICIENTS AND T-STATISTICS FOR SECOND-TERM MARINES [a]

Occupational cluster	α_1	β_1
Combat	.000729 (20.83)	[b]
Combat Support	.000652 (17.98)	.000334 (1.69)
Administration/ Logistics	.000690 (17.86)	[b]
Service	.000604 (15.38)	.00102 (4.34)
Technical	.000710 (16.91)	.00108 (4.08)
Aviation	.000817 (16.09)	.00126 (2.04)

[a] T-statistics appear in parentheses.

[b] Coefficient is not estimable due to lack of variation in bonus levels.

TABLE 11

PARTIAL EFFECTS OF ONE LEVEL SRB INCREASE
ON FIRST-TERM RETENTION[a,b]

Occupational cluster	Changes in rates		
	Stay (s)	Reenlist (r)	Extend (e)
Combat	.0140	.0605	-.0465
	(.0012)	(.0006)	(.0007)
Combat support	.0254	.0723	-.0469
	(.0013)	(.0007)	(.0006)
Administrative/logistics	.0366	.0828	-.0462
	(.0019)	(.0012)	(.0007)
Service	.0349	.0592	-.0243
	(.0019)	(.0012)	(.0007)
Technical	.0162	.0149	.0012
	(.0023)	(.0017)	(.0006)
Aviation	.0316	.0318	-.0002
	(.0020)	(.0013)	(.0007)

[a]Based upon the FY 82 pay table, a one level SRB increase corresponds to an increase in the annualized bonus payment of $820.

[b]Standard errors appear in parentheses.

We estimate that a one level SRB increase would increase the probability of staying in the Marine Corps by between .0140 for the combat cluster to .0366 for the administration/logistics cluster. The effects on the mix of reenlistments and extensions among stayers are much more varied across occupational clusters. With only two exceptions, the effects in table II are more than twice their standard errors and hence

are statistically significant. The two exceptions are the small increase in the extension rate in the technical cluster and the decrease in the extension rate in the aviation cluster.

Table 11 may also be used to predict the effects of increasing or decreasing the SRB payment by more than one multiple. This is accomplished by multiplying the numbers in the table by the change in multiples. For example, increasing the SRB payment to the combat cluster by two multiples would increase the reenlistment rate by .1210, decrease the extension rate by .0930, and increase the total probability of staying by .0280. These effects are less precisely estimated than those for a single multiple change since they are based upon extrapolation along a linear approximation (constant partial derivatives) to the non-linear equations (1) and (2). Therefore, caution should be exercised when applying the numbers in the table to large changes in the bonus multiple.

Table 12 presents our estimates of the effects of increasing first-term pay by means of an RMC increase rather than SRB increase. We consider an increase in annual RMC of $820 that is equal in value to the increase in the annualized bonus payment that would result from a one level first-term SRB increase. With our sequential logit model, the probability of staying increases by equal amounts under an RMC increase and an SRB increase. Hence, the second column of table 12 coincides with the second column of table 11 (apart from roundoff error).

However, while an SRB increase usually leads to a decline in the extension rate, an RMC increase leads to increases in both the reenlistment rate and the extension rate.

Tables 13 and 14 present our estimates of the partial effects of increases in SRB and RMC on second-term retention. While the effects of an RMC increase depend only upon the sample probabilities and the coefficients α_1, the effects of an SRB increase depend upon the coefficients β_1 as well. Recall that β_1 is not estimable in the combat and administration/logistics clusters since SRB levels were equal to zero in these clusters throughout our entire sample period. However, from tables 9, 11, and 12 it appears that the behavior of first-term personnel in the combat cluster is quite similar to that of first-term personnel in the combat support cluster. Moreover, the behavior of first-term personnel in the administration/logistics cluster is quite similar to that of first-term personnel in the service cluster. We have adopted the assumption that these similarities carry over to second-term personnel as well. Therefore, we have employed the β_1 coefficient in the combat support cluster to compute the partial effects of SRB changes in the combat cluster, and the β_1 coefficient in the service cluster to compute the partial effects of SRB changes in the administration/logistics cluster.

TABLE 12

PARTIAL EFFECTS OF $820 RMC INCREASE ON FIRST-TERM RETENTION[a]

Occupational cluster	Changes in rates		
	Stay (s)	Reenlist (r)	Extend (e)
Combat	.0139	.0066	.0074
	(.0012)	(.0006)	(.0007)
Combat support	.0254	.0136	.0119
	(.0013)	(.0007)	(.0006)
Administrative/logistics	.0367	.0223	.0144
	(.0019)	(.0012)	(.0007)
Service	.0349	.0219	.0130
	(.0019)	(.0012)	(.0007)
Technical	.0162	.0117	.0045
	(.0023)	(.0017)	(.0006)
Aviation	.0316	.0204	.0112
	(.0020)	(.0013)	(.0007)

[a]Standard errors appear in parentheses.

TABLE 13

PARTIAL EFFECTS OF ONE LEVEL SRB INCREASE ON SECOND-TERM RETENTION[a,b]

Occupational cluster	Change in rates: Stay (s)	Reenlist (r)	Extend (e)
Combat[c]	.1000	.0786	.0214
	(.0048)	(.0025)	(.0023)
Combat support	.0882	.0721	.0161
	(.0049)	(.0025)	(.0024)
Administation/logistics[d]	.0880	.1367	-.0487
	(.0049)	(.0023)	(.0024)
Service	.0774	.1304	-.0530
	(.0050)	(.0025)	(.0024)
Technical	.0978	.1298	-.0320
	(.0058)	(.0028)	(.0030)
Aviation	.1087	.1600	-.0512
	(.0068)	(.0034)	(.0034)

[a]Based upon the FY 82 pay table, a one level SRB increase corresponds to an increase in the annualized bonus payment of $1060.

[b]Standard errors appear in parenthes s.

[c]Based upon α_1 coefficient for Combat and β_1 coefficient for Combat Support.

[d]Based upon α_1 coefficient for Administration/logistics and β_1 coefficient for Service

TABLE 14

PARTIAL EFFECTS OF $1,060 RMC INCREASE ON SECOND-TERM RETENTION[a]

Occupational Cluster	Changes in rates		
	Stay (s)	Reenlist (r)	Extent (e)
Combat	.1000	.0526	.0474
	(.0048)	(.0025)	(.0023)
Combat support	.0882	.0449	.0433
	(.0049)	(.0025)	(.0024)
Administration/logistics	.0880	.0452	.0428
	(.0049)	(.0025)	(.0024)
Service	.0073	.0390	.0382
	(.0050)	(.0025)	(.0025)
Technical	.0979	.0471	.0508
	(.0058)	(.0028)	(.0030)
Aviation	.1089	.0541	.0548
	(.0068)	(.0034)	(.0034)

[a]Standard errors appear in parentheses.

The effects of a one level SRB increase on second-term retention are much larger than the effects on first-term retention reported earlier in table 11. In part, this result follows from the fact that monthly basic pay is 29 percent higher for second-term personnel than for first-term personnel, so a one level SRB increase represents a larger increase in the annualized bonus payment for second-term personnel than for first-term personnel. However, since the estimates in table 13 exceed those in table 11 by more than 29 percent, second-termers appear to be intrinsically more responsive to pay than are first-termers.

We find that an SRB increase leads to increases in the reenlistment rate in all six of the occupational clusters. The extension rate increases in the combat and combat support clusters but decreases in the other four clusters. Despite the sign reversals, all of these effects are statistically significant.

Finally, table 14 presents our estimates of the effects of increasing second-term pay by means of an RMC increase rather than an SRB increase. We consider an increase in annual RMC of $1,060 that is equal in value to the increase in the annualized bonus payment that would result from a one level second-term SRB increase. Again, an RMC increase leads to increases in both the reenlistment rate and the extension rate.

V. CONCLUSIONS

We have estimated the effects of increases in reenlistment bonuses and regular military compensation on the reenlistment and extension rates of first-term and second-term personnel in six Marine Corps occupational clusters. In particular, we find that increases in bonus levels always lead to increases in the reenlistment rate and usually lead to decreases in the extension rate. However, the increase in the reenlistment rate always exceeds the decrease in the extension rate, so that the total probability of staying in the Marine Corps increases. Our estimates should improve the ability of bonus managers to set bonus levels that will achieve desired retention rates and the desired mix between reenlistments and extensions.

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